14th Annual ALS Users' Association Meeting Workshops

ALS Infrared Spectromicroscopy and Future Infrared Sources Workshop

Upal Ghosh from Stanford University takes questions after presenting his research using synchrotron infrared spectromicroscopy to localize organic pollutants in soils and sediments. Larry Carr from the NSLS presides.

A two-day workshop on current and future synchrotron-based infrared spectroscopy and spectromicroscopy was convened as part of the annual Advanced Light Source (ALS) Users' Association Meeting on October 16-17, 2001 at the Lawrence Berkeley National Laboratory (Berkeley Lab). The workshop attracted over 60 scientists, had 17 invited presentations, and four break-out group discussions. The organizers were Michael C. Martin and Wayne R. McKinney (ALS), Dimitri N. Basov (University of California, San Diego), G. Larry Carr (National Synchrotron Light Source), Zack Schlesinger (University of California, Santa Cruz) and Gwyn P. Williams (Thomas Jefferson National Accelerator Facility). The detailed program is available on-line at: http://infrared.als.lbl.gov/IRworkshop01.html

The workshop was divided into two days: the first day was devoted to sharing infrared spectromicroscopy results done primarily at the ALS infrared beamlines and to infrared spectromicroscopy applications in general. A wide range of scientific topics was covered, which made for a well-rounded and very interesting day. On the second day, ideas for building a dedicated infrared ring at the ALS were presented, and more importantly, the science that will drive such a facility was discussed. Four discussion groups—medicine and biology, environmental and earth sciences, complex materials, and semiconductors, materials and surface science—spent several hours discussing the forefronts of their scientific disciplines and how a new high-brightness infrared facility could help enable new research and discoveries.

After initial welcoming comments by Martin, Upal Ghosh (Stanford University) made the first presentation of the day discussing his group's "Microscale Investigation of Location and Association of Organic Pollutants in Soils and Sediments." James Chesko (Chiron Corporation) gave a perspective from biotechnology companies with his talk titled "Applications of Vibrational Spectroscopy to Biotechnology Research and Development." Willem Wolkers (University of California, Davis) continued the biological topics, presenting "In situ FTIR assessment of cytoplasmic glasses and heat stability of proteins in plant tissues." Wendy Panero (University of Michigan) turned the discussion to high-pressure studies of water uptake in minerals with her presentation on "Oceanography of the Earth's lower mantle: synchrotron FTIR studies of nominally anhydrous minerals." After a break, Daniel Fried (University of California, San Francisco) reported on his investigations into new ways to treat and protect teeth in "IR Spectroscopy of Laser Irradiated Dental Hard Tissues using the ALS."

The topics then shifted to complex materials and material science beginning with Chris Weber (University of California, Berkeley) discussing the progress of his group's measurements on "Infrared Conductivity of Photo-Induced Charge Carriers in Molecular Crystals." Larry Carr (NSLS) presented a talk describing the pump-probe far-IR measurements he has developed: "Time-Resolved Far-IR Studies of Metallic Superconductors." Sherry Zhang (Berkeley Lab) rounded out the morning with a presentation about her studies involving "Infrared in Lithium-Ion Batteries."

Following lunch, Forrest Sedgwick (University of California, Berkeley, and Berkeley Lab) gave a "Demonstration of New Spectral Sorting Software" that he has written and which will be made freely available to the community in the near future. The workshop then heard about the latest infrared microscopy instrumentation developments by Bonnie Leimer (Thermo Nicolet Corporation) in a talk on "Advancements in Micro-Sampling Technology." Kelly Knutsen (University of California, Berkeley) presented his initial progress towards getting even higher resolution using "Infrared Near-Field Microscopy."

Felicia Betancourt (Berkeley Lab) followed with her presentation "Infrared Spectroscopy of Thin Films of Water and Aqueous Solutions: A Preliminary Study." The final presentation of the day completed the diverse array of talks with a plant-biology presentation by Theodore K. Raab (Carnegie Institution) titled "Infrared Spectromicroscopy and Genetic Dissection of Plant Cell Wall Architecture." The workshop attendees then joined with those from other ALS workshops for a poster session and the users' meeting dinner and awards.

Daniel Chemla, Director of the ALS, kicked off the second day of the infrared workshop. Fernando Sannibale (ALS Accelerator Physics Group) presented a discussion about "A Dedicated storage ring for IR and Far-IR synchrotron radiation at the ALS." This presentation detailed the initial ideas that an ALS IR ring working group has developed, along with some as-yet unfixed parameters that will be determined by the needs of the scientific users. The IR ring would operate in two modes: a conventional synchrotron mode, which would be primarily geared toward high-brightness and excellent beam stability for mid-IR spectromicroscopy, and a coherent mode, where the electron bunches would be shortened significantly to the point where superradiant far-IR emission is generated with flux enhancements of four to six orders of magnitude over the conventional mode in the wavelength regime $\lambda > 100$ microns. The ring would be injected at full energy using the existing ALS injector and would be located on the roof of the ALS booster synchrotron shielding tunnel. The rest of the day was devoted to discussing the science that would drive such a facility and what the most important capabilities of a new IR synchrotron should be.

Before breaking out into discussion groups, the workshop heard from a leader from each group about some of the science that they view as at the forefront of their fields and about some of the overall issues for new infrared sources and instrumentation. Hoi-Ying N. Holman (Berkeley Lab) began by discussing her recent environmental research with a presentation titled "Catalysis of PAH Biodegradation by Humic Acid Shown in Synchrotron Infrared Studies." Mike Jackson (National Research Council Canada) then presented some of his ideas about the impact on medical and biological research by the use of synchrotron infrared facilities and where this type of research may be leading. Tom Timusk (McMaster University) discussed some of the scientific and technical issues in far-IR measurements of strongly correlated materials.

The attendees then divided into working groups, where more detailed discussions of the cutting-edge science and necessity for new infrared capabilities were held. The results of these working groups are being compiled into a document for forthcoming distribution. The overall conclusion of the workshop was that there is a lot of high-quality research being performed with synchrotron infrared beamlines around the world and that there is a scientific need for even better infrared sources, such as a dedicated IR ring. ■

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